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Artistic Drawing as a Mnemonic Device

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ARTISTIC DRAWING AS A MNEMONIC DEVICE

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ARTISTIC DRAWING AS A MNEMONIC DEVICE

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DOCTOR OF PSYCHOLOGY

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Dedication

This dissertation is dedicated to my late father, Theodore Baker, one of my greatest teachers. He taught me patience and perseverance, and showed me that with a little faith and a lot of hard work, anything is possible.

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ABSTRACT

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Despite art-based learning being widely used, existing data are primarily qualitative, and most research has not isolated particular variables such as memory for empirical study. The few experiments that have been conducted demonstrated that drawing improves free recall of unpaired words, and retention improves after lessons integrated with drawing, drama, and narrative exercises. To help fill the gap in the current literature, the present study compared the effectiveness of encoding and the rate of memory decay between a drawing mnemonic and note taking on a paired associates task. Using a within-subjects experimental design, participants were presented with word pairs and asked to complete either a drawing mnemonic (DM) or note taking (NT) to assist memorization. Participants were tested immediately after the word pair presentation and after a 20-minute delay. Results supported the hypothesis that the DM condition would produce superior encoding, as evidenced by greater retention on the immediate test. However, no memory decay was observed in the experiment, and therefore results on the delayed test were inconclusive. In fact, scores for the NT condition improved over time whereas the scores for the DM condition did not, which might imply that note taking results in a different consolidation process than drawing. Findings from this study suggested that arts integration can be an effective method to support memory for learned information. Future studies that examine the effect of rehearsal and the long-term effectiveness of a drawing mnemonic are warranted.

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Chapter I: Introduction

Art-based learning is one method that may increase both the effectiveness of learning and the motivation to learn. Art-based learning, also called arts-integration, is an educational technique that utilizes art to facilitate learning. Although its exact origins are unclear, art-based learning has arguably existed since prehistoric cave paintings (Siler, 2011). The Aztecs of ancient Mexico used painted books to record and share their past, their ideology, their way of life, and predictions of the future (Boone, 2009). In addition, throughout time religious art has been used as a way to communicate, persuade, and teach religious beliefs (Mirmobiny, 2011). Yet art-based education as a distinct discipline did not gain particular significance until the development of progressive education, which began in the early twentieth century and was revived in the 1960s and 1970s (Bresler, 1995). Since then, art-based learning programs have been implemented in various settings such as K−12 programs, medicine, business, community based programs, and art therapy education.

In order to investigate the effectiveness of art-based learning, the concept of learning must first be defined. Learning is the procurement of new knowledge, abilities or cognitive strategies (Kazdin, 2000). Kazdin referred to learning and memory as “two sides of a coin;” although they are two separate concepts, one is not possible without the other. Learning is the acquisition of information, whereas memory is the retention of that learning. However, this distinction is not always this clear within the literature, and the two terms are often used synonymously. For example, Kazdin describes both learning and memory as possessing the same processes of encoding, storage, and retrieval. Encoding entails information acquisition and processing, storage is the maintenance of this information, and retrieval involves accessing the stored information.

The ability to learn and memorize information is important for success in many areas of life, particularly education. College acceptance is contingent on passing college entrance exams, and candidates with high SAT or ACT scores have a better chance of acceptance. Additionally, tests are regularly administered during college courses, most notably mid-term and final exams. Thus, the ability to remember information is imperative for both college acceptance and success.

If producing art could successfully be used as a mnemonic, students might be able to perform better on tests for three reasons (which the following literature review will detail): a drawing mnemonic may increase encoding, retention, and retrieval of information; art-making in general may improve memory functioning; and art may increase motivation and enjoyment with learning, which could in turn affect attention and therefore retention of concepts. For these reasons, the current study's purpose is to examine if visual art production is an effective modality to memorize information.

The literature review will first examine the different memory systems and processes to further define the construct of memory. It will then provide theoretical support for image creation as a mnemonic device by exploring the superiority of visual memory and the effectiveness of elaborative encoding and mental imagery as mnemonic devices. Next, the effects of art on overall cognitive performance and the transfer of learning will be investigated. Lastly, the literature will be reviewed for current evidence that demonstrates the effectiveness of art-based education. Throughout the review of the literature, gaps in the existing knowledge base will be identified to further strengthen the rationale for the current study.

Chapter II: Literature Review

Overview of Memory

Before the late 19th century, memory was thought of as a unitary construct (Schacter & Tulving, 1994). Near the end of the 19th century, the possibility of different forms of memory had been theorized, yet interest in the subject quickly dissipated. Theories of multiple forms of memory reappeared after World War II, but it was not until the 1960s and 1970s that substantial interest on memory as a multifaceted concept developed. In particular, the concepts of short-term and long-term memory were heavily discussed. That being said, it is now widely accepted that memory has multiple forms and elements (Schacter & Tulving, 1994).

Since memory is now generally considered a multi-component system, this section will distinguish the specific aspects of memory that were examined in the present study. Tulving (1995) divided memory concepts into two main classes: memory systems and memory processes. Memory systems reflect the different types of memory, whereas memory processes involve the manner in which information is encoded and stored. For this reason, this section investigates the different types of memory systems and the theoretical mechanisms involved in memory processes.

Memory systems. A *memory system* is, “an interaction among acquisition, retention, and retrieval mechanisms that is characterized by certain rules of operation.” (Sherry & Schacter, 1987, p. 440). Sherry and Schacter argued that evolution creates *adaptive specialization* to confront demands of an organism’s environment. This adaptive specialization creates *functional incompatibility,* in that one function is unable to serve other functions due to its specialized nature. Thus, multiple memory systems have evolved in order to meet the many needs of being human.

Tulving (1985) distinguished three major memory systems: episodic memory, semantic memory, and procedural memory. Episodic memory refers to memories of specific events that have occurred at a particular place and time. Semantic memory is knowledge for facts and concepts that are not obtained from experienced events. Procedural memory retains information on how to perform certain skills and habits. These three systems exhibit a *monohierarchical* arrangement (i.e., hierarchical arrangement in which each concept belongs to only one broader parent concept), in that procedural memory is at the lowest level of the hierarchy and contains semantic memory as a specialized subsystem. Next in the hierarchy is semantic memory, which contains episodic memory as a specialized subsystem. In other words, since procedural memory helps us remember connections between stimuli and responses, it requires semantic memory, which creates mental representations of our environment. Likewise, episodic memory allows us to remember events and mentally relive them, and therefore is dependent on these mental representations. This monohierarchical arrangement implies that only procedural memory can function independently of the other systems, semantic memory can operate independently from episodic memory only, and episodic memory cannot work independently from any other system.

Two other major memory systems that were later recognized are the perceptual representation system (PRS) and working memory (Tulving, 1995). PRS identifies words and objects and occurs at a presemantic level. In other words, it perceives the form (such as the order of letters) but not the meaning of stimuli. PRS is responsible for perceptual priming, which is the nonconscious and implicit memory effect of one stimulus influencing the memory of another. Lastly, working memory, also referred to as primary memory and short-term memory, refers to accessible short-term retention.

Baddeley called working memory, "an alliance of separate but interacting temporary storage systems, possibly coordinated by a single central executive component." (Baddeley, 1983, p. 311). As the amount of information to hold in working memory increases, reasoning takes longer. This process and corresponding storage systems will be discussed in more detail in the next section.

It should be noted that there is no clear cut definition of working memory, with at least three different definitions in the literature (Cowan, 2008). The first definition states that it is short-term memory as applied to cognitive operations. The second definition refers to it as a multi-component system used to manipulate information held in short-term memory. The third definition explains working memory as the utilization of attention in short-term memory. Cowan distinguished working memory as separate from short-term memory, in that working memory is specifically for the purpose of understanding, reasoning, and manipulating information. However, many of the theories in this section refer to working memory synonymously with short-term memory. For this reason, this literature review will not include a distinction between working memory and short-term memory, and will use the terms interchangeably.

Memory systems should not be confused with implicit and explicit memory, which are forms of the expression of memory (Tulving, 1995). Implicit memory is the expression of memory with no consciously associated acquisition, whereas explicit memory is the expression of memory with an associated event. Episodic memory and working memory are considered explicit memory, whereas procedural, semantic, and PRS are considered implicit memory.

Applicability of memory systems to this study. Kazdin (2000) defined learning as an enduring change in behavior due to experience. Thus, true learning for information would be reflected in semantic long-term memory. For this reason, this study did not focus on short-term or working memory. Instead, it concentrated on semantic long-term recall of word pairs, as well as rate of memory decay over a 20-minute period.

Memory processes. As stated previously, there are three stages of memory processing: encoding, storage, and retrieval (Kazdin, 2000). In addition, the act of converting short-term to long-term memory is called consolidation (Muller & Pilzecker, 1900 as cited in Lynch, Kramár, & Gall 2014). Evidence of a consolidation process can be seen on a physiological level. Data suggests that memories move from the temporal lobe to the neocortex as memories age and become more stable (Bayley, Hopkins, & Squire, 2006; Smith & Squire, 2009). This process is called *systems consolidation.* Additionally, long-term memory may establish new synaptic connections in a process called *synaptic consolidation* (Bailey & Chen, 1988; Tominaga-Yoshino et al., 2008). Conceptually, the details involved in encoding, consolidation, storage, and retrieval processes have been debated, resulting in various models of memory processes.

Atkinson-Shriffrin memory model. The Atkinson-Shriffin memory model compares the brain to a computer information processing system (Atkinson & Shriffin, 1968). According to this theory, memory consists of permanent memory structures (the hardware) and control processes that are constructed and selected by the individual (the software). Atkinson and Shriffin distinguished three different memory structures through which data pass: the sensory register, the short-term store, and the long-term store. The sensory register perceives and registers information from the outside world; this information either decays rapidly or is passed into the short-term store. Information in the short-term store decays in a 15- to 30-second period unless a rehearsal control process is used. Rehearsal, a common control process of repetition, can preserve a limited amount of information in the short-term store. Information from the short-term store may eventually be copied into the long-term store, which is relatively permanent storage (though information can be modified or become temporarily irretrievable).

Baddeley's model of working memory. Baddeley and Hitch (1974) modified the Atkinson-Shriffin model in two ways: they conceptualized short-term memory as consisting of three components and serving a working memory function, in that it holds information for cognitive manipulation. They hypothesized that working memory consisted of a supervisory system called the *central executive*, and two slave systems called the *visuospatial sketchpad* and the *phonological loop*. The visuospatial sketchpad holds visuospatial information, and the phonological loop holds verbal and acoustic data. The phonological loop consists of the phonological store and the articulatory control process. The phonological store holds auditory or speech-based information for 1−2 seconds. The articulatory control process is associated with inner speech and serves two functions: it rehearses verbal information to further maintain it in the phonological store, and it registers visual information (e.g., written words or nameable pictures) in the phonological store.

Baddeley (2000) later expanded this model to also include the episodic buffer, which integrates visual, spatial, and verbal information. The episodic buffer acts as an intermediary between working memory and long-term memory in order to bind visual and auditory information, as well as information pertaining to time and order. The central executive controls the episodic buffer, and can retrieve data from this temporary store into conscious awareness.

Tulving's SPI model. Tulving (1995) attempted to merge the concepts of memory systems and memory processes in his SPI model, which stands for serial encoding, parallel storage, and independent retrieval. The model assumes that information is encoded serially, in that one system's output becomes another system's input. The model also states that information is stored in different systems in a parallel fashion; a single instance of encoding produces simultaneous storage in multiple systems. Lastly, retrieval of information is independent, as information can be retrieved from one system without retrieval from another system. This model applies to what Tulving considered *cognitive* memory systems—PRS, semantic memory, working memory, and episodic memory (i.e., all memory systems except procedural memory).

According to this model, structural features of stimuli (e.g., the physical appearance of words) are registered in the PRS as data that can either later be retrieved through priming or can be relayed to the semantic system (Tulving, 1995). The semantic system elaborates this information (e.g., connects words to their meanings) and forwards it to the brain for storage, as well as sends the information to the working memory and episodic memory systems. The working memory system can further elaborate this information through rehearsal or other encoding strategies. The episodic memory system can process the information in terms of time and space, connecting it already existing episodic information.

Levels of processing model. Craik and Lockhart (1972) questioned the accuracy of a multi-store memory system, arguing that instead memory was a continuum based on how well information is encoded. According to this theory, retention is linked to "levels of processing," which range from a shallow level of perceptual processing to a deeper level of semantic processing. When a memory trace (the physical substrate of memory) is thereby formed, depth of processing correlates to memory trace persistence. This theory considers short-term memory to be information maintenance at a shallow level of processing. Craik and Lockhart (1972) stated, “At deeper levels the subject can make greater use of learned rules and past knowledge; thus, material can be more efficiently handled and more can be retained.” (p. 676).

The levels of processing theory does not argue against the distinction of short-term and long-term memory (Lockhart & Craik, 1990). Rather it argues against the presence of structural memory stores, the notion that the stores' properties determine retention, and the idea that memory theories should be refined according to the existence of these stores.

Applicability of memory processes to this study. Since there is no universally accepted theory of memory processes, it is difficult to state the present study's focus in a manner that is compatible with all theories. If using the Atkinson-Shriffin memory model (Atkinson & Shriffin, 1968), the present study investigated the effect of a drawing mnemonic as a control process on long-term memory stores. From the approach of Baddeley's model of working memory (Baddeley, 1974; 2000), the present study evaluated the effect of a drawing mnemonic on encoding in the visuospatial sketchpad, and possibly the phonological loop (through the articulatory control process) and episodic buffer. Looking at memory through Tulving's SPI (Tulving, 1995) lens, the present study evaluated a drawing mnemonic's effect on the semantic system, in that it added meaning to the memorized material. Lastly, if viewing memory through a levels of processing framework (Craik & Lockhart, 1972), the present study looked at the effect of a drawing mnemonic on depth of processing. This study will not be viewing memory through solely one theoretical lens, so therefore, terminology will be used in a manner that remains agnostic regarding which theory is most accurate.

Theoretical Support for Image Creation as a Mnemonic Device

Rinne, Gregory, Yarmolinskaya, and Hardiman (2011) described eight effects of art-based learning that may help retention of concepts: rehearsal, elaboration, generation, enactment, oral production, effort after meaning, emotional arousal, and pictorial representation. *Rehearsal* is the repetition of information to aid with memory. Although rehearsal can be practiced through other means, art may be a more engaging method for doing so. *Elaboration* is the act of adding meaning to subjects to assist with memorization, which art often does naturally. Art also requires *generation*, the act of generating information from one's mind rather than merely reading it, and *enactment*, the process of "acting out" material to be learned. *Oral production*, which can be found in theater and music, is the act of orally producing information rather than just reading it. *Effort after meaning* is effortful cognitive processing that helps with concept memorization. Art is often an emotional process, and *emotional arousal* may help make information more memorable. Lastly, *pictorial representation* is inherent in visual art, and results from memory studies indicate that pictures are recalled better than words. This occurrence is called the picture superiority effect.

Picture superiority effect. The human brain has a vast capability to remember visual stimuli. In a study of 14 adults, Brady, Konkle, Alvarez, and Oliva (2008) presented 2,500 images for three seconds each, and participants were subsequently tested with a two-alternative forced-choice test. This procedure presented two images and instructed participants to identify the previously viewed image. The images had three variations: novel, exemplar, and state. The novel condition presented a choice between the previously seen stimulus and an entirely different object (e.g., a stack of blankets and a clock). The exemplar condition presented a choice between two types of objects (e.g., a stack of five dollar bills and a stack of one dollar bills). The state condition presented the same object in different states (e.g., a cabinet with doors closed and a cabinet with a door open). Participants correctly recognized 92.5% of the novel stimuli, 87.6% of the exemplar stimuli, and 87.2% of the state stimuli. This study demonstrates participants' remarkable capacity to remember visual details, which lends support to visual art-based learning's effectiveness.

Other data indicate visual memory's superiority to other forms of memory, lending credence to a potential advantage for a visual-based mnemonic (such as drawing) relative to verbal mnemonics (auditory or written). For example, our image recognition ability is greatly superior to our auditory recognition ability; auditory recognition *d'* scores (determined by calculating hit rate versus false alarm rate) vary from 1.83 to 2.7, whereas visual recognition *d'* scores have been found to be 3.57 (Cohen, Horowitz, & Wolf, 2009). Individuals also have a greater capacity to remember images than written words on tests of explicit memory (Childers & Houston, 1984; Paivio & Csapo, 1969; Nicolas, 1995; Shepard, 1967). Shepard (1967) found recognition memory *d'* scores to be 1.79 for words, 1.68 for sentences, and 2.98 for pictures.

The most commonly accepted interpretation behind the picture superiority effect is the dual-coding hypothesis (Paivio, Rogers, & Smythe, 1968). This proposition emphasizes the encoding processes involved in memory, which are, "sensory, perceptual, and higher level cognitive processes whose function is to transform objects and events from the outside world into their coded representations in the mind/brain." (Kazdin, 2000, p. 163). The dual-coding hypothesis states that images are encoded both via verbal and visual pathways, whereas words are encoded only verbally (Paivio et al., 1968). As a result, more memory trace is available to individuals when remembering images (Paivio et al., 1968).

Paivio and Csapo (1969) tested the dual-coding hypothesis in two experiments that presented concrete words, abstract words, and labeled pictures via a slide projector at two rates– a fast rate that did not allow time for pictures to be verbally named, but allowed sufficient time to recognize the pictures and implicitly (outside of consciousness) read the words, and a slow rate that provided enough time to implicitly name the pictures. Paivio and Csapo did not instruct participants to label the pictures, assuming that individuals would automatically and implicitly name the pictures if given adequate time. Results indicated that pictures were recalled better than words in most slow rate tests, but not in fast rate tests. Paivio and Csapo reasoned that these findings were due to pictures being dually encoded during the slow rate, but encoded through only one pathway at the fast rate.

Additionally, Paivio and Csapo (1973) found supporting evidence for the dual-coding hypothesis in a series of five experiments. The most convincing implication came from the fifth experiment, in which they presented participants with a series of words, pictures, repetitive pictures (picture-picture), repetitive words (word-word), and pictures and words of the same stimulus (picture-word). The researchers found the normal picture superiority effect with single words and pictures, no differences between the single picture and word-word conditions, greater recall for the picture-word condition than the word-word condition, and no significant differences between picture-word and picture-picture conditions. These data suggest that images and words are encoded via independent pathways, and an additive effect occurs when both pathways are used. Moreover, the fact that no differences were found between the picture-word and picture-picture conditions lends support to the theory that pictures employ both pathways.

An alternative explanation theorizes that the picture superiority effect is due to more distinctive sensory encoding for images than words. Nelson, Reed, and Walling (1976) demonstrated that the picture superiority effect is not present in a pictorial paired associates task when the stimuli are schematically or conceptually similar, supporting the notion that distinctive sensory cues achieve the picture superiority effect. However, the presence or vividness of color actually decreases the memorability of images, suggesting that sensory distinctiveness is not causing the picture superiority effect (Childers & Houston, 1984; Paivio et al., 1968). Whatever the reason may be, the evidence indicates that pictures are explicitly remembered better than words (Childers & Houston, 1984; Paivio & Csapo, 1969; Nicolas, 1995; Shepard, 1967). These results lend support to the hypothesis that education that employs visual memory strategies such as drawing may be more effective than education that merely uses verbal means of teaching and learning.

Often educational content is not naturally visual, such as names of historical figures or abstract vocabulary terms. However, visual memory's superiority can also be utilized to remember non-visual stimuli. Maguire, Valentine, Wilding, and Kapur (2003) compared the fMRIs of individuals with superior memorization ability (the highest achieving participants of the World Memory Championship) to those of a control group while asking them to remember series of numbers, faces with names, and snowflakes. The superior memorization (SM) group scored significantly higher than the control group on working and long-term verbal memory tests, but did not differ from the control group in general intellectual ability or brain structure. In terms of the serial numbers, face, and snowflake memorization tasks, the largest difference between groups was on the number memorization task, with the SM group significantly outperforming the control group. The SM group also performed significantly better than the control group on the face-name memorization task, but the difference was not as great as for the serial number task. No reliable differences were found between groups on the snowflake memorization task. For all memory tasks, the SM group had higher activity in the medial parietal cortex, retrosplenial cortex, and the right posterior hippocampus. These brain areas have been implicated in spatial memory and navigation.

Subsequent debriefing revealed that the SM group used mnemonic strategies, and 9 out of 10 used the 'method of loci' strategy (Maguire et al., 2003). This strategy entails visualizing items placed at certain points of a familiar route (such as the drive to work), and then imagining the route during recall. By replacing numbers with a visual image (e.g., a snowman for an "8"), non-visual stimuli can be remembered visually. Differences in brain activity between groups were therefore likely due to the use of the method of loci strategy. Interestingly, the control group also reported using general visual strategies for the faces and snowflakes, but not for the numbers.

The varying use of visual strategies may be why the number memorization task had the largest difference between groups. In other words, it is the use of visual strategies that produced the differences in results, rather than intrinsically superior memory (otherwise, a difference between the ability to recall snowflakes would have been found; Maguire et al., 2003). This idea is supported by other observations of people with high memory capacity; these individuals do not have better memory per se, they merely use mnemonic strategies more often (Ericsson & Chase, 1982). In fact, Foer (2011) described his journey from being a self-proclaimed forgetful person to the 2006 World Memory Champion through the use of mnemonics.

Effectiveness of mnemonics. This section will demonstrate that superior memory is not a completely inborn trait, and memory can be trained through the use of mnemonics. Through process called *recoding*, mnemonics transform the original representations into more memorable ones (Kazdin, 2000). If the dual-coding hypothesis holds true, image creation can recode information both visually and verbally. It also is a form of elaborative encoding, as it can add meaning to encoded material.

Elaborative encoding. A commonly used mnemonic is elaborative encoding, the process of adding meaningful information to make a stimulus more memorable. Art has the ability to add meaning to rather meaningless stimuli. For example, the name Descartes is rather meaningless. However, by illustrating the Cartesian split through the use of drawing, the name becomes much more meaningful (see Figure 1).

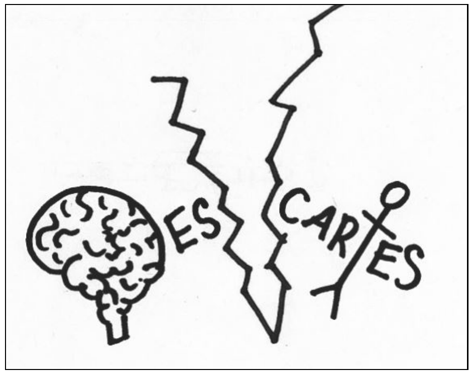

Figure 1. Art mnemonic for Descartes.

The theory that people remember meaningful stimuli more than meaningless stimuli is supported by a study by McWeeny, Young, Hay, and Ellis (1987). The researchers demonstrated that individuals have better recall for occupations than proper names, most likely because occupations are more meaningful. They presented participants with the occupations and surnames of 16 photographs of people, half of whom had surnames that could also be occupations (e.g., Baker, Cook, or Porter). The researchers found that participants recalled the occupation without a name more frequently than they recalled a name without an occupation, even if the last name could also be considered an occupation.

Cohen (1990) termed the tendency to remember occupations better than names the Baker-baker paradox, which states that the surname Baker is more difficult to remember than the occupation baker because it is less meaningful. To demonstrate the paradox, Cohen presented 30 participants with 12 photographs of individuals and provided three facts about the individual. For half of the participants, one of the facts was a non-word, for example, “This man is called Mr. Hobbs. He is a pilot. He has a blick” (Cohen, 1990, p. 290). The researcher reasoned that if names are more difficult to remember because they are meaningless, then participants should remember non-words less often. Results indicated that names and non-words were equally forgettable, and real-word possessions and occupations were remembered more often.

Mental imagery. Based on the theory that meaningful information is more memorable, Morris, Jones, and Hampson (1978) used a mental imagery technique to help participants remember names. Participants were instructed to find a semantic association of a name (e.g., Gordon = garden) and a prominent facial feature (e.g., nose), then pair the two visually (e.g., imagining a garden on his nose). No significant differences in remembering face-name pairs were found between the control group and the experimental group prior to training; however, after training the experimental group performed significantly better on the recall test.

Coane (2013) also demonstrated that using a mental imagery strategy increased retention and recall in "young" and "older" adults (p. 96). Although the exact age range of the groups was not provided, the young adults had a mean age of 19.74 and the older adults had a mean age of 67.44. Both sets of participants were exposed to one of the following conditions: Study-Test (ST) condition, Study-Study (SS) condition, and the Deep Processing (DP) condition. Each group was asked to memorize a list of 44 word pairs (e.g., *demon-dark*) in four phases: initial learning phase, second learning phase, a test after 10 minutes, and a test after two days. The SS condition instructed participants to study the word pairs presented on a computer in any way they chose. The first phase of the ST condition was identical to the SS condition, but the second phase displayed the first word only and asked participants to type the missing word. The DP condition asked participants to find a connection between the two words in the initial phase, and to create a mental image that connected the two words in the second phase. Results indicated no significant differences in recall after 10 minutes, but after two days both the ST and DP groups significantly outperformed the SS group. There were no significant differences between age groups on recall.

Similarly, Brooks (1999) used a three-part process to train older adults to memorize proper names (paired with photographs) and the order of a word list. Pre-training consisted of participants learning imagery and observation techniques, mental image formation, verbal elaboration strategies, and relaxation training. The two-week, two-hour per day training consisted of learning a name-face mnemonic and the method of loci strategy. Adults who received mnemonic training significantly outperformed the control group. This study lends support to the effectiveness of mental imagery in combination with other mnemonic strategies; however, it also indicates that substantial training time can be needed to teach mnemonics.

Additionally, Lima-Silva et al. (2010) showed that using mental images to memorize words, short phrases, and short stories significantly improved delayed recall in 32 older adults compared to a control group of 37 older adults. However, the treatment group had higher pre-test scores on the Mini Mental State Exam (MMSE) and lower scores on the Geriatric Depression Scale. Training consisted of five 90-minute training sessions, 45 minutes of which was dedicated to psychoeducation intended to change negative beliefs about memory and aging, and the remaining 45 minutes was dedicated to learning mental imagery techniques. Although this study offers no conclusive evidence for the effectiveness of mental imagery as a mnemonic device (due to the treatment group having higher pre-test MMSE scores and lower Geriatric Depression Scale scores), it does demonstrate that substantial training time is needed to teach these techniques.

Imagery is inherent in drawing, and therefore visual art may assist with elaborative encoding. For instance, in addition to visualizing a “dark demon,” an individual could also depict one through art. Learning a drawing mnemonic may require less training time than learning other mnemonic strategies, while also providing additional benefits such as increased engagement and enjoyment.

Effects of Art on the Transfer of Learning

Forming connections are essential to learning, and art-based learning may create these associations between and within disciplines (Marshall, 2005; Siler, 1996). Siler (1996) has coined the term *metaphorming* to describe the associative process of art-based learning, which provides individuals the opportunity to alter their perceptions and understand subjects differently. Similarly, Marshall (2005) stated that arts-integration encourages relational learning by helping individuals form connections between subjects, expand upon and re-conceptualize ideas, and broaden thinking by blurring categorical distinctions. Consequently, art may innately promote transfer, the ability to apply learned skills in one are to another (Catterall, 2002, 2005; Marshall, 2005; Posner & Patoine, 2010; Ross & Raffa, 1984).

Posner and Patoine (2010) argued that art develops analytical and attentional skills that may encourage transfer. Math, reading, and writing are all expressed symbolically, giving reason to believe that communicating symbolically through art may help development in other disciplines (Ross & Raffa, 1984). Catterall (2005) argued that arts-integration also encourages meta-cognitive processes through inner dialogue on the artistic process, and facilitates thorough understanding of subjects by provoking meaningful conversations with others. Catterall (2002) also postulated that art may increase self-confidence and intrinsic motivation, which in turn can improve functioning in other areas.

Indeed, studies suggest that art may improve overall cognitive performance (Catterall, Dumais, & Hampden-Thompson, 2012; Hetland & Winner, 2001; Ottarsdottir, 2010;

Schellenberg, 2004; Wandell, Dougherty, Ben-Shachar, Deutsch, & Tsang, 2008). Cognition among children with learning difficulties has improved after art education therapy (Ottarsdottir, 2010). Correlational data suggest that early visual arts experience predicts greater phonological awareness, and preliminary data suggest visual art training predicts math calculation ability (Wandell et al., 2008). Among low socioeconomic status high school students, engagement with the arts (e.g., lessons in music, dance, drama, or visual arts, and involvement with arts activities or organizations) has been positively correlated with higher grade point averages, greater chances of completing a calculus class, and desire to attend college (Catterall et al., 2012). In 10 meta-analyses of 188 studies from 1950−1999, Hetland and Winner (2001) found three causal relationships between the arts and cognitive function: listening to music caused temporary spatial-temporal reasoning improvement, music training improved spatial-temporal reasoning, and dramatic classroom readings enhanced verbal skills.

Rosier, Locker, and Naufel (2013) also found a link between visual art and memory in a series of two experiments. In the first experiment, 80 Introductory Psychology students were assigned to one of four conditions: viewing an inkblot and drawing art (to engage both visual processing and creative production), viewing works of art, discriminating geometric shapes (either through viewing pairs of shapes and indicating if they were the same or different, or by labeling shapes), and writing a short description about courses in which they were currently enrolled. Participants were then presented with seven randomly paired words and were subsequently tested. Next, participants were administered a creativity measure, which categorized their type of creativity, and a personality measure, which assessed how much the participant identified with being creative. Individuals were significantly more likely to remember word pairs if they had participated in the drawing task prior to memorization. No significant differences were found between type of creativity or degree of participant creativity.

In a second experiment, Rosier et al. (2013) aimed to equalize the conditions to assess if it was truly creative activity or other differences such as visual-motor processing that produced superior results in the drawing condition. One-hundred seventy two students enrolled in an introductory psychology course were assigned to one of four conditions: the same drawing condition as in Experiment 1, viewing an inkblot, copying the inkblot (visual-motor processing without creativity), and writing about classes they had taken in their last year of high school. Results from the second experiment were similar to the first; participants who underwent the drawing condition significantly outperformed the others, and no significant differences were found in the rest of the conditions. These experiments suggest that creative art-making that precedes learning can improve overall memory function, however these experiments did not evaluate whether learning through art improves encoding. Rosier et al. recommended that students create art during study breaks to increase retention. Yet, Rosier et al. did not consider that if participants could memorize information through producing art, rather than following the creation of art, they may be more engaged in the learning process.

Effectiveness of Art-Based Learning

Experimental and quasi-experimental evidence. Although there is much evidence that suggests that art in general improves cognition, there are few studies that evaluate quantitative data or demonstrate causation of art-based learning. The research that does exist suggests that arts-integration increases memory for learned information.

Paivio and Csapo (1973) investigated the use of drawing to memorize pictures and words in 28 males and 53 females enrolled in an introductory psychology class. The intent of the experiment was to investigate the picture superiority effect, but results have direct implications on using drawing as a mnemonic device. Participants were presented with 72 pictures or 72 words for $^{1}/_{16}$ second each at five-second intervals. Participants were assigned to one of four conditions, in which they were instructed to either draw an image of a word, copy a stimulus drawing, write the names of pictures, or write the stimulus word. After stimuli presentation, participants were given a sheet of paper and asked to recall as many items as they could. Participants in the drawing conditions recalled almost twice as many stimuli than participants in the word writing condition. No significant differences were found between labeling a picture and drawing a picture. Data derived from this study suggests the effectiveness of visual art-based learning. However, the study only used solitary pictures and words of objects. Classroom learning does not typically involve encoding of singular items, but rather an association between two abstract stimuli (e.g., associating a historical event with a date). For this reason, further study of drawing's effect on remembering associated information was necessary.

Other experiments have looked at associative memory and mixed media arts-integration (e.g., drama, visual art, etc.). In a classroom setting, Hardiman, Rinne, and Yarmolinskaya (2014) substituted certain classroom activities with art activities for 97 fifth graders. All participants were African American, 47% were female, and 14% identified as having a disability. The researchers created three-week arts-integrated units in astronomy and ecology in which students drew responses to worksheet questions (rather than writing them), read stories (rather than informational texts), performed dramatic plays (in place of both reading aloud and presentations), and created drawings to elaborate vocabulary terms (rather than writing). To ensure all participants received benefits from the arts-integrated lessons, half of the participants were assigned to an arts-integrated astronomy unit and a non-arts-integrated ecology unit, and the other half were assigned to a non-arts-integrated astronomy unit and an arts-integrated ecology unit. Results indicated a significant main effect for the substituted art activities and a significant interaction between arts integration and reading proficiency. Students at "basic" reading levels benefitted most from arts integration, performing .9 *SD* higher on the post-test than control group participants at the same level. This study suggests that art-based learning improves retention in school children. However it was unknown which of the substitutions (dramatic plays, storytelling, or drawing) had the largest impact on memory.

DeMoss and Morris (2002) also examined the effects of arts-integrated versus traditional lessons in a quasi-experimental design. Teachers participating in the study identified two similar academic units, and agreed to teach one unit with arts integration and the other without. Student pre- and post-writing samples were evaluated for depth of knowledge, analytic assessments, and affective responses on a seven-point scale. Although no differences occurred in depth of knowledge or writing skill (interpretation, analysis, synthesis, or evaluation of subject), arts units' post-writing samples demonstrated more advanced analyses of subject matter importance, greater engagement with the subject, and more positive feelings associated with learning. This study indicates arts-based learning's influence on student engagement. However, the method for examining depth of knowledge was questionable. Even with a point system to evaluate writing, the study still relied on subjective evaluator opinion. Additionally, arts units consisted of multiple modalities, with at least one unit focused solely on theater. Therefore, conclusions regarding visual arts' effect on memory cannot be made from this study.

Correlational evidence. Correlational studies also indicate promising results. The A+ School Program is an art-based educational program created in 1995 by the Thomas Kenan Institute for the Arts. Barry (2010) investigated the program in Oklahoma and found that A+

School students' standardized test scores were generally at or above state averages. In addition, A+ schools had significantly higher Academic Performance Indices, which are a compilation of Oklahoma School Testing Program scores, school completion rates (attendance, dropout, and graduation rates), and advanced class placement. Methodological issues call these results into question, as confounding variables such as socioeconomic status were not controlled. In fact, A+ schools had more racial minority and low socioeconomic students than other Oklahoma schools that were studied. Studies have suggested that the subconscious influence of stereotypes can lower test scores (Steele & Aronson, 1995; Walton & Spencer, 2009). Therefore, the effect of art-based learning on test scores may actually be understated.

Additionally, Kimball (2006) found slightly superior math and reading scores in the A+ schools when compared to a matched sample. The difference in math scores was significantly higher in A+ schools, with an effect size of .17 Reading improvement's effect size was .12 and was not statistically significant (Kimball, 2006). Although these effect sizes have typically been considered small (Cohen, 1992), Hill, Bloom, Black, and Lipsey (2008) argued that effect sizes should be interpreted within context rather than by an overarching guideline. Average effect sizes for educational interventions range from .2 to .3 (Hill et al., 2008). The effect size for math scores found by Kimball is comparable to other educational interventions (e.g., implementation of after-school programs, family support programs, etc.), and therefore arts integration could be interpreted as an effective intervention.

Thomas and Arnold (2011) also evaluated the A+ Schools Program. In comparison to the state reading average, 20 A+ schools performed below and 19 performed at or above the state average. Additionally, 27 performed below the state math average, and 11 performed at or above the state average. Data such as these may be misrepresenting art-based learning effectiveness though, as the study did not account for socioeconomic status or other potential confounds. These methodological limitations warrant further study of the A+ Schools Program, and art-based learning in general.

Qualitative evidence. The majority of art-based learning studies are qualitative and dependent on participant opinion. These qualitative studies have suggested that art-based education broadens participant perspective, aids with learning, and creates strong student engagement (Clover, 2006; Collins & Ogier, 2012; Deaver, 2012; de la Croix, Rose, Wildig, & Willson, 2011; Hughes, 2009; Sutherland, 2013). An analysis of art therapy graduate students' essays revealed that art deepened understanding of abstract concepts, facilitated self-exploration and personal growth, and documented the graduate experience (Deaver, 2012). In an art-based exploration of identity, children became actively engaged in exploring the commonalities between themselves and others, discovering multiple levels of identity, and challenging preconceived notions of identity (Collins & Ogier, 2012). Through creating and presenting artwork, individuals in a leadership and management course learned about different experiences and perspectives in a manner that they found to be less restrictive than traditional learning (Hughes, 2009). Community art projects on antiracism suggested that art-based learning encouraged dialogue, allowed individuals to express themselves in ways that language could not, and slowed the reflection process to strengthen learning (Clover, 2006).

These studies suggest that art-based learning is an effective and engaging educational experience. However, most research has looked at the concept as a whole and has not investigated particular aspects of learning, such as attention, memory, or ease of understanding. Memory is essential to learning; yet memory has received little attention from the art-based learning literature. For this reason, further study of arts-integration on memory was necessary.

Rationale

Despite the multitude of studies on art-based learning (e.g., Barry, 2010; Clover, 2006; Collins & Ogier, 2012; de la Croix et al., 2011; Deaver, 2012; Hughes, 2009; Kimball, 2006; Sutherland, 2013; Thomas & Arnold, 2011), little research is available on adults using objective measures of memory. Most research that has been conducted relied on participant opinion rather than concrete and measurable evidence (e.g., Clover, 2006; Collins & Ogier, 2012; de la Croix et al., 2011; Deaver, 2012; Hughes, 2009; Sutherland, 2013). Existing quantitative research is primarily correlational and has been conducted on children or adolescents (e.g., Barry, 2010; Kimball, 2006; Thomas & Arnold, 2011). As stated previously, Paivio and Csapo (1973) showed that drawing pictures improved recall in adults; however they investigated memory for singular objects rather than memory that associates stimuli. Other studies that have explored art-based learning's effectiveness have evaluated the combined effect of several modalities (drama, music, etc.) (e.g., Hardiman et al., 2014; DeMoss & Morris, 2002). Furthermore, most of the literature has evaluated art-based learning holistically and has not isolated particular variables such as memory (e.g., Barry, 2010; Clover, 2006; Collins & Ogier, 2012; de la Croix et al., 2011; Deaver, 2012; DeMoss & Morris, 2002; Hughes, 2009; Kimball, 2006; Sutherland, 2012; Thomas & Arnold, 2011).

Therefore, an experimental design was needed to evaluate the effectiveness of visual art-based memorization in adults. The present study was intended to clarify whether visual art-based learning assists memory to an extent equal to or greater than that of the traditional learning strategy of writing notes. Finding either of these results would provide individuals with an effective and engaging way to memorize information. If the drawing condition received a larger effect, it might indicate that drawing is more effective than note-taking, and thus it would be advantageous to create visual representations to memorize information. However, even if the effect was equal for both conditions, individuals who find drawing more enjoyable could utilize a drawing mnemonic and still receive the same benefits as note-taking.

Hypotheses

The present study's primary objective was to determine the effectiveness of image creation as a mnemonic. The experiment's hypotheses were: (a) Word pairs memorized using the drawing mnemonic will produce higher post-test scores, and (b) After 20 minutes, word pairs memorized in the DM condition will have a smaller decrease in scores (lower rate of memory decay) than those memorized in the NT condition. Such results might suggest that art-based learning improves encoding and memory storage.

Chapter III: Method

Reasoning for Experimental Design

The existing studies on art-based learning are primarily qualitative and/or correlational designs. Additionally, studies have tended to focus on many different forms of art and all aspects of learning rather than just memory. Therefore, the present study utilized an experimental design and isolated memory as a dependent variable. Additionally, the use of an experimental design allowed for control of extraneous variables, thereby supporting inferences of causation. An experimental design is high in internal validity (compared to correlational or quasi-experimental designs), because the potential for interference from extraneous variables is reduced (Heppner, Wampold, & Kivlighan, 2008).

A within-subjects design was used because fewer participants were needed to achieve adequate statistical power than a between-subjects design (Heppner et al., 2008). Using this type of design reduces error variance, as participants serve as their own controls. Additionally, a within-subjects design does not include threats to validity that might affect a between-subjects design, such as compensatory equalization of treatments (enhanced services provided to the control group due to experimenter guilt), and compensatory rivalry (control group participants exerting more effort in an attempt to outperform the experimental group). For these reasons, a within-subjects experimental design was the most suitable option for the research question.

Design

The present study examined the creation of visual artistic representation as a mnemonic device. Due to the literature's emphasis on encoding as the theoretical basis for the picture superiority effect (i.e., studies by Nelson et al., 1976; Paivio & Csapo, 1969; 1973; Paivio et al., 1968 focused on encoding), this study specifically investigated the effectiveness of a drawing mnemonic on encoding. It also attempted to assess the rate of memory decay in a 20-minute period.

After a brief practice trial, each participant was presented with word pairs and was instructed to use a drawing mnemonic (DM) to memorize half of the word pairs (two sets of 11 word pairs), and use note taking (NT) to memorize the other half (two sets of 11 word pairs). A recall test was administered immediately after the participant had completed all conditions to assess encoding. An additional test was administered 20 minutes after the first recall test to assess rate of memory decay. The independent variables for this study were Study Condition (Drawing Mnemonic and Note Taking) and Time Delay, and the dependent variable was post-test scores.

Participants were presented with word pairs previously used in studies by Maddox, Balota, Coane, and Duchek (2011) and Coane (2013). The present experiment used 44 word pairs chosen randomly from the original list of 150 word pairs, using a random number generator from random.org (word pairs assigned numbers one through 44 were chosen for this study). Word pairs were presented in four different learning phases (A, B, C, and D), described below.

A within-subjects crossover design was used. In this type of design, all participants underwent the same conditions (DM and NT), but were randomly assigned to one of two groups (Group 1 and Group 2) that differed in the order of presentation of the experimental conditions. Experimental condition presentation order for Group 1 was as follows: 11 word pairs were presented using DM (Learning Phase A), 11 word pairs using NT (Learning Phase B), 11 word pairs using DM (Learning Phase C), and 11 word pairs using NT (Learning Phase D). Group 2 underwent the same conditions in a counterbalanced fashion (NT-DM-NT-DM) (see Table 1).

Table 1

Counterbalanced Presentation Order

Learning Phase	Group 1 Presentation Order	Group 2 Presentation Order
A	1. 11 word pairs using DM	1. 11 word pairs using NT
B	2. 11 word pairs using NT	2. 11 word pairs using DM
C	3. 11 word pairs using DM	3. 11 word pairs using NT
D	4. 11 word pairs using NT	4. 11 word pairs using DM

In addition to counterbalancing, word pairs for each learning phase were randomly selected to reduce differences between conditions. Additionally, immediate and delayed tests were designed to be as equal as possible, and therefore word pairs were randomly assigned to each test.

Participants

Participants were a convenience sample of 36 individuals. Participant inclusion criteria were individuals between the ages of 18 and 70 with a high school diploma or GED. Exclusion criteria were obvious intoxication or drug-induced impairment, vision impairment, dyslexia, or fine motor impairment.

Materials and Measures

Materials and measures for the present study included a demographic data form (Appendix A), the Coding subtest from the Wechsler Adult Intelligence Scale, fourth edition (WAIS-IV) (Wechsler, 2008a), the Verbal Paired Associates I and Visual Reproduction I from the Wechsler Memory Scale, fourth edition (WMS-IV) (Wechsler, 2008c), and the Baker Paired

Associates Program. The order of presentation of the measures is further outlined in the Procedure section.

Demographic data form. The demographic data form (Appendix A) was used to describe the sample. The form consisted of questions pertaining to age, gender, race, sexual orientation, education, employment, income, language spoken, and disability status.

WAIS-IV Coding subtest. The WAIS-IV is a widely used intelligence examination that has been standardized on 2,200 adolescents and adults (16−90 years-old), with the exception of three subtests (Letter-Number Sequencing, Figure Weights, and Cancellation) that were standardized on 1,800 individuals ages 16−69 (Wechsler, 2008a). The standardization sample consisted of 13 age groups, with 200 participants in each of the first nine age groups (16−69 years-old) and 100 participants in the last four age groups (70−90 years-old). The age groups from 16−64 had an equal number of men and women, and the age groups from 65−90 had more women than men to match census data. The sample consisted of Euro American, African American, Hispanic American, Asian American, and Other. Individuals in each age group were matched to the general population in terms of ethnicity, geographic region, and education. The WAIS-IV is considered to have excellent reliability; the Processing Speed subtest reliability is based on test-retest reliability coefficients, and ranges from .87 to .92. The WAIS-IV Coding subtest was chosen for the present study because it assesses processing speed, which is an important component of word presentation tasks. Scores from the WAIS-IV Coding subtest were used to describe the sample, and to ensure participants had at least average processing speed.

WMS-IV Verbal Paired Associates I and Visual Reproduction I. The WMS-IV is one of the most commonly used memory batteries (Rabin, Barr, & Burton, 2005). The WAIS-IV and WMS-IV were co-normed, but data collection continued for the WMS-IV beyond that of the WAIS-IV to achieve a mean General Abilities Index of 100 in each of the age bands (Wechsler, 2008c). From the WMS-IV normative sample, 1,400 individuals were included with 100 individuals in 14 age bands (Wechsler, 2008c). Like the WAIS-IV, gender, ethnicity, education, and geographic region mimicked census data (Wechsler, 2008c). Verbal Paired Associates I and Visual Reproduction I were among the most reliable subtests of the WMS-IV Adult battery, with reliability coefficients of .94 and .93 respectively (Wechsler, 2008c).

The Verbal Paired Associates I subtest assesses linguistic memory by requiring participants to repeat a list of paired words (Wechsler, 2008d). The word pairs in the WMS-IV are similar to the word pairs in the present study in that some are semantically related and others are not. This subtest helped determine a baseline of linguistic memory.

The Visual Reproduction I subtest evaluates visual recall by instructing participants to draw stimulus pictures from memory. This subtest was chosen due to its similarity to the DM's use of visual memory. If participants had very poor visual memory, it would seem to reason that the usefulness of the DM would be diminished.

Baker Paired Associates Program (BPAP). The BPAP is a word pair presentation and testing computer program that was created by James Baker, a software engineer, through Google App Engine. The BPAP was given an obscure URL that cannot be found during a web search. The first screen requires the experimenter to enter the participant code. After entering the code, the experimenter is given the option to click either the "Note Taking Trial," "Drawing Mnemonic Trial," "Initial Learning Phase [A, B, C, or D]," "Test 1," or "Test 2" buttons. The Note Taking Trial and Drawing Mnemonic Trial each presents participants with two word pairs. Practice trials are administered first to allow participants to practice each memorization technique. After the practice trials are complete and any questions are answered regarding the procedure, the Initial Learning Phases are administered. The Initial Learning Phases presents participants with the four sets of 11 word pairs. Each word pair is presented at 25-second intervals to allow adequate time to create an image. A 500-millisecond lapse occurs between each word pair similar to the study by Coane (2013). Word pairs are displayed in 72-point Helvetica font, and the first word has a colon after it (e.g., SWEET : FISH). A display bar indicates how much time is remaining for each item, and a tone occurs after 25 seconds has passed, alerting participants to the next question. Test 1 tests participants on 22 word pairs (11 word pairs randomly selected from the DM condition and 11 randomly selected from the NT condition) by displaying a word and an adjacent text box where participants type the associated word. Test 2 tests participants on the remaining word pairs.

For computer scoring purposes, words need to be entered exactly, with no variations. For this reason, font type for participants' responses are all capital letters and the examiner is required to check answers for misspellings or typos after the participant leaves. The program produces a total score and a table for each participant with the following columns: test item number, answer given, and points earned per item (1 for correct, 0 for incorrect). Misspellings or typos are manually corrected on this table. Upon test completion, results are automatically emailed to a designated email address to provide data backup.

Procedure

Pre-participant procedure. After obtaining Antioch University Institutional Review Board approval, participants were recruited through Craigslist, email, and snowball sampling. Snowball sampling is a form of sampling that relies on informal word-of-mouth recruitment of future participants by current participants. Emails were sent to individuals at the author's place of employment (Brown and Caldwell, an environmental engineering firm) with permission from the Brown and Caldwell West Region Human Resources Manager.

All experimental sessions were conducted on an individual basis to limit confounding influences associated with the presence of other individuals. Participants recruited through Craigslist were tested at Antioch University Seattle. Participants recruited by word-of-mouth snowball sampling were tested either at their homes or at Antioch University Seattle. For Brown and Caldwell participants, testing occurred in a conference room at the Brown and Caldwell Seattle office. When scheduling the appointment (via phone or email), participants were instructed to abstain from alcohol and drugs for 24 hours before the experiment.

Random assignment for experimental conditions was accomplished by using a number series created by a random number sequence generator (from random.org), where 1 represented Group 1 and 2 represented Group 2 (see Appendix B). The number was matched according to the sequential order of participant testing. For instance, the first three numbers given on the random number sequence are 1, 2, and 2. Therefore the first person tested was in Group 1, the second person was in Group 2, and the third person in Group 2.

Participant confidentiality. Participant responses and scores were assigned a unique identifier to conceal participant identity. Identifiers were date and military time of initial testing followed by group number (e.g., Group 1 participant tested on April 3, 2015 at 12:00 PM was 201504031200-1), and were handwritten in the upper right-hand corner of the consent forms and all written measures. Informed consent forms and protocols were kept in a locked file at the author's residence. Informed consent forms and protocols existed in hard copy form only.

Participant experience. A script for the experiment that the examiner followed is located in Appendix C. The procedure is outlined in Table 2 and explained further below.

Table 2

Procedure

Event	Approximate Time
1. Participant was assigned to Group 1 or 2.	n/a
2. Participant greeted by examiner and given gift card.	<1 minute
3. Informed consent was reviewed and signed.	5 minutes
4. Presentation of word pairs.	20 minutes
5. Immediate post-test administered.	10 minutes
6. Sudoku puzzles.	20 minutes
7. Delayed post-test administered.	10 minutes
8. Subtest administration	20 minutes
WAIS-IV Coding.	
WMS-IV Visual Reproduction I.	
WMS-IV Verbal Paired Associates I.	
9. Demographic data form completed.	1 minute
10. Debriefing	5 minutes
Total	~1.5 hours

Upon arrival, participants were greeted by the examiner, given a $20 gift card to Amazon.com, and were provided an informed consent form explaining the procedure. Participants were assured that they are not being tested on their artistic ability or note taking, and that the drawing and notes were merely a tool to help them memorize the words. The researcher reviewed the informed consent form with participants, answered any questions, and asked them if they would like to participate. Everyone who scheduled an appointment agreed to participate and signed the required consent form.

Upon completion of the informed consent form, the BPAP was administered. The BPAP presented the word pairs and subsequently tested the participants via two tests (see Materials and Measures section for exact specifications). The Note Taking Trial and Drawing Mnemonic Trial allowed participants to practice each technique before being presented with the word pairs they would be tested on. When undergoing the DM condition, participants were instructed to draw an image that associated the two words (see Appendix C). Participants were given a stack of white 8½” x 11” paper and a black pen to complete their drawings. When undergoing the NT condition, participants were instructed to write notes in any way that helped them memorize the word pairs (see Appendix C for instructions).

Upon completion of the word pair presentation (all four sets of 11 word pairs), participants were immediately administered the appropriate test. Tests were counterbalanced between groups; Group 1 was administered Test 1 first and Group 2 was administered Test 2 first. Each test presented half (22) of the word pairs, half randomly selected from word pair lists of each condition. Similar to the study by Coane (2013), participants had unlimited time to respond to word prompts to reduce test anxiety, and therefore produce more valid results.

After completion of the test, a filler task (beginner-level Sudoku puzzle) was administered for 20 minutes. If participants finished the first Sudoku puzzle, they were administered a second Sudoku puzzle (difficult Sudoku puzzle). This filler task was followed by administration of the other test (Test 2 for Group 1 and Test 1 for Group 2).

The Coding, Visual Reproduction I, and Verbal Paired Associates I subtests were then administered to participants (in that order). Following subtest administration, participants were asked to complete a demographic data form (Appendix A), but were instructed to skip any questions they felt uncomfortable answering (also noted on the form).

Participants were debriefed afterward to allow them to ask questions or state concerns. The examiner answered questions pertaining to general information about the hypothesis and reasoning for procedures. Specific performance information was not provided, as scoring did not occur until after the participant had left.

Chapter IV: Results

The sample consisted of four participants from Craigslist, 22 participants from Brown and Caldwell, and 10 participants from word-of-mouth snowball sampling. All participants met inclusion criteria, but one participant's data were excluded because he started drawing during the NT condition. The demographic data of the participants is listed in Table 3.

Table 3

Demographic Data

Demographic	Group 1		Group 2	
	M	*SD*	*M*	*SD*
Age	36	10	38	12

Demographic	Group 1		Group 2	
	n	%	*n*	%
Biological Sex				
Female	8	47%	10	56%
Male	9	53%	7	39%
Gender				
Female	8	47%	10	56%
Male	9	53%	7	39%
Androgynous	0	0%	1	6%
Sexual Orientation				
Heterosexual	15	88%	13	72%
Bisexual	1	6%	4	22%
Other	0	0%	1	6%
Relationship Status				
Single	5	29%	6	33%
Partnered	5	29%	4	22%
Married	6	35%	8	44%
Divorced	2	12%	1	6%
Widowed	1	6%	0	0%

Demographic	Group 1		Group 2	
	n	%	*n*	%
Ethnicity				
Asian	0	0%	2	11%
Caucasian	17	100%	17	94%
Hispanic	0	0%	2	11%
Native American	0	0%	1	6%
Education				
High School Diploma	2	12%	0	0%
GED	0	0%	1	6%
Associate	0	0%	3	17%
Bachelor	7	41%	6	33%
Master	5	29%	7	39%
Doctoral	2	12%	1	6%
Other	1	6%	0	0%
Employment				
Full time	14	82%	10	56%
Part time	2	12%	5	28%
Student	1	6%	3	17%
Annual Income				
\$0−\$9,999	1	6%	0	0%
\$10,000−\$19,999	0	0%	3	17%
\$20,000−\$29,999	1	6%	1	6%
\$30,000−\$49,999	4	24%	4	22%
\$50,000−\$79,999	5	29%	3	17%
\$80,000−\$99,999	3	18%	1	6%
\$100,000+	3	18%	6	33%
Primary Language				
English	17	100%	18	100%
Disability Status				
Non-disabled	16	94%	15	100%
Disabled	1	6%	3	83%
Nerve Damage	1	6%	0	17%
Hearing	0	0%	1	6%
AD/HD	0	0%	1	6%
PTSD	0	0%	1	6%

Note. The following ethnicities were not represented in this sample: African American, Pacific Islander, and Other.

Scaled scores on the Coding, VR, and VPA subtests suggested average to above average processing speed and memory. Mean scaled scores on the Coding (M = 11.94, SD = 2.89) and VR (M = 11.94, SD = 2.67) subtests were within the average range. Mean scaled scores on the VPA (M = 13.29, SD = 2.62) were above average, suggesting an advantage for verbal memory over visual memory that is higher than the general population.

Mean scores of the test taken immediately after the word pair presentations were higher for the Drawing Mnemonic (DM) condition (DM M = 7.74, DM SD = 2.59; NT M = 6.80, NT SD = 2.93). Mean scores of the delayed test were approximately equal for both conditions (DM M = 7.54, DM SD = 2.67; NT M = 7.57, NT SD = 2.76). Results of a t-test revealed that the DM immediate condition significantly outperformed the NT immediate condition, $t(34) = 3.222$, $p = .003$, d = .55. There were no significant differences between conditions on the delayed test, $t(34) = -.075$, $p = .941$, d = .013. Differences between the immediate and delayed tests for the DM condition were not significant, $t(34) = .684$, $p = .498$, d = .116. Differences between the immediate and delayed tests for the NT condition were significant, but were contrary to the hypothesis that a 20-minute period would create memory decay, as the mean score actually increased over time, $t(34) = -2.143$, $p = .039$, d = .363.

The differences between the NT immediate and NT delayed conditions were not normally distributed, as assessed by Shapiro-Wilk's test ($p = .03$). Data were transformed using a reflect and square root transformation. Shapiro-Wilk's test demonstrated that transformed data were normally distributed ($p = .09$). A t-test with transformed data indicated a miniscule change in significance, $t(34) = 2.154$, $p = .038$. Therefore, original data were kept for clarity. One outlier was detected, but a subsequent analysis with the outlier removed indicated no difference from the analysis that included the outlier.

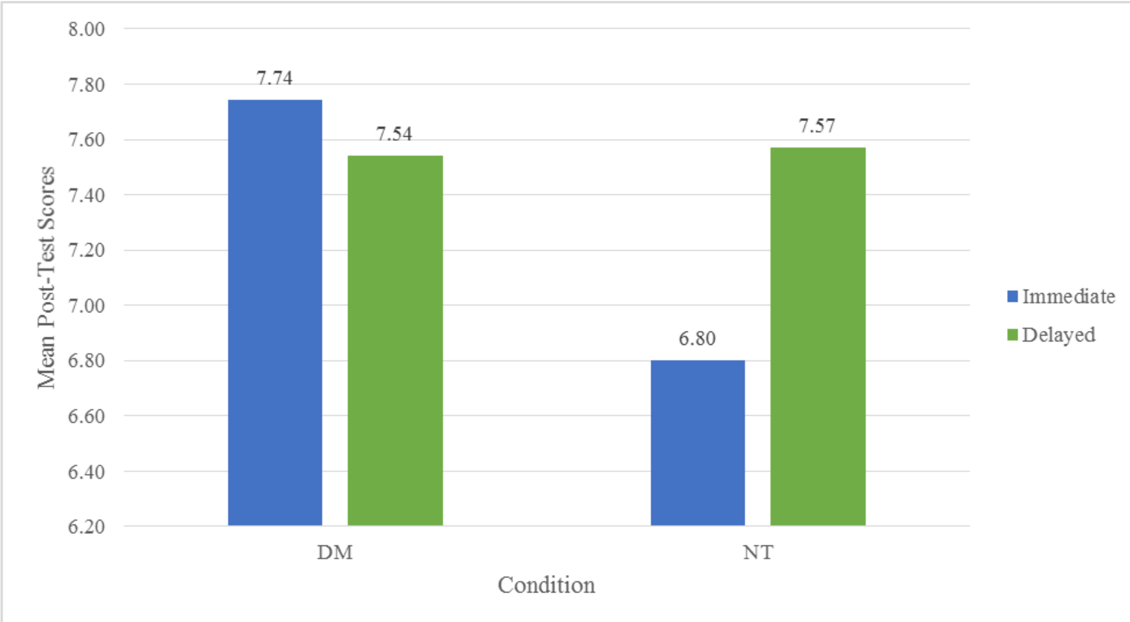

Figure 2. Mean correct recall on the tests immediately and after a 20-minute delay as a function of condition.

In addition to comparing mean scores, a statistically significant percentage of the sample scoring better in one condition than the other demonstrates the effectiveness of each condition. After removal of data for participants who scored equally on both tests, scores were submitted to a binomial test to determine significant differences between percentages. Results from the immediate post-test supported rejection of the null hypothesis, as the proportion of individuals who performed better on the DM test of .75 was higher than the expected .5 (p = .017). Although the proportion of .55 of individuals who performed better using NT on the delayed test of was higher than the expected .5, results were not significant (p = .711).

Scores were also analyzed using a two-way repeated measures analysis of variance (ANOVA) to compare the overall effectiveness of the DM condition to the overall effectiveness of the NT condition, and also to determine if there was a significant interaction between Condition and Time Delay. Although there was a trend for the DM condition (M = 7.64, *SD* = 2.62) to outperform the NT condition (*M* = 7.19, *SD* = 2.85), results were only marginally significant, $F(1, 34) = 3.141$, $p = .085$, $\eta_p^2 = .085$. Due to scores on the NT delayed test being higher than the NT immediate test, the overall mean of immediate tests for both conditions (*M* = 7.27, *SD* = 2.79) was lower than mean of the delayed test (*M* = 7.56, *SD* = 2.69), but the difference was not significant, $F(1, 34) = 1.395$, $p = .246$, $\eta_p^2 = .039$. There was a statistically significant interaction between Condition and Time Delay, $F(1, 34) = 4.82$, $p = .035$, $\eta_p^2 = .124$, with the DM condition having a higher rate of memory decay (the NT condition indicated improved memory rather than memory decay).

Data was non-normally distributed in the DM immediate ($p = .031$), DM delayed ($p = .042$), and NT delayed ($p = .039$) conditions, as assessed by Shapiro-Wilk's test. Data were transformed using a reflect and square root transformation. Shapiro-Wilk's test indicated that transformed data were normally distributed for the DM immediate ($p = .23$), DM delayed ($p = .10$), NT immediate ($p = .34$), and NT delayed ($p = .15$) scores. A two-way repeated measures ANOVA of transformed data did not create meaningful changes in significance of results for condition, $F(1, 34) = 2.716$, $p = .11$, $\eta_p^2 = .074$, time, $F(1, 34) = 1.682$, $p = .20$, $\eta_p^2 = .047$, or their interaction, $F(1, 34) = 4.18$, $p = .049$, $\eta_p^2 = .11$. Original data were kept for clarity. Again, one outlier was detected, but a subsequent analysis with the outlier removed revealed no difference from the analysis that included the outlier.

A post-hoc power analysis revealed that the ANOVA may have lacked adequate statistical power to produce significant results on both Condition and Time Delay. Both variables had power below the recommended .8 level (as described by Cohen, 1992). The analysis indicated that power to detect an effect size of .3 for Condition was .41 and power for Time Delay was .21.

Potential sequence effects may have confounded results, although use of random assignment and counterbalancing should have mitigated any sequence effects. Nevertheless, t-tests were performed to assess significant differences between Group 1 and Group 2. No significant differences were found between the groups in the DM immediate testing condition, Group 1 $M = 7.47$, $SD = 3.22$, Group 2 $M = 8$, $SD = 1.879$, $F(1, 33) = -.6$, $p = .55$, NT immediate testing condition, Group 1 $M = 6.71$, $SD = 3.18$, Group 2 $M = 6.89$, $SD = 32.76$, $F(1, 33) = -.182$, $p = .86$, DM delayed testing condition, Group 1 $M = 7.41$, $SD = 2.92$, Group 2 $M = 7.67$, $SD = 2.5$, $F(1, 33) = -.278$, $p = .78$, or the NT delayed testing condition, Group 1 $M = 7.65$, $SD = 3.24$, Group 2 $M = 7.5$, $SD = 2.3$, $F(1, 33) = .155$, $p = .88$. These results suggest that sequence effects did not significantly influence the BPAP scores.

Pearson correlations measured relationships between the difference in the DM and NT Baker Paired Associates Program (BPAP) scores and the scaled scores from the Coding, VPA, and the VR subtests. No significant correlations were found between differences on the immediate test and Coding, $r(33) = -.218$, $p = .21$, VPA, $r(33) = -.17$, $p = .34$., or VR, $r(33) = -.052$, $p = .77$, subtests. No significant correlations were found between differences on the delayed test and Coding, $r(33) = -.06$, $p = .72$, VPA, $r(33) = -.263$, $p = .13$, or VR, $r(33) = -.142$, $p = .42$, subtests. These results suggest that individual participant differences in processing speed, verbal memory, and visual memory did not significantly influence differences in BPAP scores.

Chapter V: Discussion

The present study compared drawing with note taking on a paired associates task using word pairs. Two hypotheses were tested; the first hypothesis stated that the Drawing Mnemonic (DM) condition would produce superior recall of word pairs than the Note Taking (NT) condition, and the second hypothesis stated that the DM condition would have a lower rate of memory decay. Each hypothesis is discussed in more detail below.

Hypothesis 1

The null hypothesis that the DM condition would not significantly differ from the NT condition was rejected for the immediate test only. Results indicated that the DM condition produced significantly superior results on the immediate test, but no difference on the delayed test.

In addition to statistical significance, results on the immediate test also reflected a medium effect size (d = .55). Whereas statistical significance only indicates the probability of the results being extreme given the null hypothesis, effect size helps demonstrate the actual effect of the experimental condition, also known as practical significance. The medium effect size on the immediate test implies practical significance of a drawing mnemonic. These data suggest that drawing is more effective than note taking for recall during the period shortly after learning word pairs (< 20 minutes).

There is insufficient evidence to reject the null hypothesis for aggregate scores of both post-tests. That is to say, the DM condition was not found to be significantly more effective than the NT condition overall. Although overall the DM condition outperformed the NT condition, results were only marginally significant (p = .085). However, the sample lacked adequate statistical power, with 59% probability of Type II error. Therefore, there is a good chance that a larger sample would render this result significant.

Hypothesis 2

The null hypothesis that the DM condition would not significantly differ in rate of decay from the NT condition could not be rejected. In fact, the NT condition had no decay and scores actually increased. One possible reason for this result is that taking notes improves memory after 20 minutes. Perhaps the 20-minute period helps consolidate memory when information is memorized using note taking, but similar consolidation does not occur over this time period when information is memorized using drawing.

Evidence suggests that a delay can improve memory. A study by Darby and Sloutsky (2015) indicated improved memory in children after a 48-hour delay in comparison to a one-minute delay when learning stimuli contingencies. Henderson et al. (2015) showed that memory for novel words improved after a 24-hour delay in both children and adults. Brown, Weighall, Henderson, and Gaskell (2012) showed improvement in recognition of novel words in seven-year-olds after three to four hours, but no improvement in recall until 24 hours later. These studies suggest that offline processes (i.e., processes that occur when not in the active process of learning) help strengthen and stabilize memories. Perhaps note-taking catalyzes these offline processes in a way that drawing does not, or the memory trace formed from drawing is more difficult to consolidate. In other words, although drawing initially produces superior encoding, it might produce inferior consolidation.

The added task of needing to connect images to words might contribute to this inferior consolidation. Anecdotal comments from participants suggested that they often remembered the image they drew, but not the words that were associated with the image. Due to this study being the first of its kind to represent word pairs using drawn images, no research is available to determine if this finding is unique to this study. That being said, this effect has not been reported in studies of mental imagery (Coane, 2013; Lima-Silva et al. 2010; Morris et al., 1978). Recognition testing, rather than free recall testing, might have reduced this effect, but pilot testing indicated that recognition tests produced ceiling effects.

The inability to remember the verbal information that accompanies drawings suggests that the picture superiority effect might have occurred, but without further rehearsal, the exact words associated with the images were lost. Since drawing to memorize information is a novel idea, many participants likely did not know how exactly to create a picture that would best represent the stimulus words. Participants likely had more experience with NT than DM, making the creation of visual representations within a limited time frame a more difficult endeavor.

The DM condition might have produced higher post-test scores if additional practice was provided for a DM. Individuals were only given one practice trial with little instruction on how to complete the DM. Further practice with a DM would reduce the difficulty inherent in learning a new form of studying, behaviorally condition individuals to be less apprehensive about creating art, and help individuals learn the most effective way to represent the word pairs.

Additionally, many of the word pairs seemed to have been semantically encoded in both conditions, but the exact word could not be recalled. Several incorrect answers were synonymous or similar to the correct answer. For instance, for the word pair “turkey” and “killed,” many people typed “dead” instead of the correct answer “killed.” It could be fruitful for future research to include analyses of synonyms of the correct answers, to determine if there is a significant difference in semantic encoding and recall between DM and NT conditions.

Another interpretation of the current study's results is that memory trace formed from drawing might not consolidate as rapidly. Results for the DM condition could be interpreted as memory holding steady over a 20-minute period rather than decaying, since the decrease in scores between the two post-tests was not significant. Perhaps DM scores would improve after a longer time period.

Ortiz and Wright (2010) showed different rates of consolidation depending on the type of information learned; specifically conceptual versus stimulus learning. Conceptual learning involves general qualities of a trained condition (e.g., procedure and task), whereas stimulus learning involves specific features of information learned (e.g., the specific placement of an object). Using an auditory discrimination task, the researchers found that conceptual learning occurred 10 hours after training, but stimulus learning did not occur until 24 hours after training. Although these results do not have direct implications for the current study, they do suggest that different forms of learning depend on offline processes that can occur at different rates. Thus, it is possible that after a longer delay, DM scores would improve in a similar fashion to NT scores. More research is therefore necessary to see how a drawing mnemonic affects memory over time.

Similarly, Tse et al. (2007) showed that systems consolidation can occur at different rates depending on pre-existing knowledge. The researchers trained rats to learn associations between flavors and certain locations (Tse et al., 2007). After making hippocampal lesions 24 hours after training, Tse et al. discovered that the rats that had prior training could remember newly paired associates whereas those that did not have prior training could not. These results suggest that memory traces for previously trained rats had moved from the hippocampus to another area of the brain, likely the neocortex, through systems consolidation at a rapid pace. Thus, having pre-existing schemas accelerated systems consolidation.

Since DM is a novel concept but NT is not, it is possible that in the present study the pre-existing schema of NT affected the consolidation rate. In other words, if DM was a more familiar mnemonic strategy, perhaps consolidation would occur at a similar rate. Therefore, as stated previously, research that allows more practice of a DM might be beneficial.

Another possibility, though perhaps an unlikely one, is that the Sudoku puzzle affected consolidation differently for the DM and NT conditions. Perhaps a distractor task interferes with consolidation of information from a DM, but NT uses different neural pathways that are more resistant to retroactive interference in the form of Sudoku. Retroactive interference occurs when newly acquired information interferes with the retention of previously acquired information (Briggs, 1954). Two contributing factors to retroactive interference are the similarity of the interfering stimuli to the learned stimuli (associative interference), and how quickly the interfering event occurs after the original stimuli is learned (processing interference) (Runquist, 1975). Levy-Gigi and Vakil (2012) demonstrated that participants performed poorer on recall when interference was in a similar format to either visual or verbal information learned. Sudoku depends primarily on visual strategies rather than verbal ones, so it is possible that Sudoku created greater retroactive interference for the DM condition than the NT condition. Future research should investigate different distractor techniques and their influence on a DM's effectiveness.

Whatever the case may be, the premise that a 20-minute period would allow for memory decay was mistaken, and therefore the second hypothesis that the DM condition would reduce memory decay was not supported. A 20-minute time delay was chosen primarily due to practicality considerations. This choice was in accordance with the precedent set by the WMS-IV battery, as 20 minutes is the minimum time delay allowed between WMS-IV VPA I and VPA

II subtest administrations. However, the nature of this study encouraged elaborative encoding, whereas the VPA subtest likely does not provide adequate time for elaborative encoding. For that reason, 20 minutes is likely an inadequate duration to produce memory decay for information memorized using elaborative encoding.

Coane (2013) demonstrated that a delay of two days was enough time to produce decay for word pairs memorized using elaborative encoding techniques of mental imagery or finding similarities between word pairs. Additionally, McCabe (2015) showed that a delay of three days produced memory decline for information learned through an instructor provided mnemonic, a self-generated mnemonic, and real life examples. Thus, two to three days might be an adequate time delay to produce memory decay, and future research that allows at least a two day delay to determine decay differences between DM and NT is warranted.

Another possibility is that the tests and order of word pair presentation were biased. Word pairs for each test were randomly chosen, but it is possible that one test had a higher amount of more recent (i.e., later in the word pair presentation) or easier to remember word pairs. This was likely not the case though, because tests and conditions were counterbalanced and no significant differences were found between groups.

Implications of Findings

This study is one of the few quantitative experimental studies to examined the effects of visual art-based learning. Several qualitative studies have suggested that art enriches the subjective experience of learning (Clover, 2006; Collins & Ogier, 2012; Deaver, 2012; de la Croix et al., 2011; Hughes, 2009; Sutherland, 2013), and correlational studies have demonstrated a relationship between arts integration and academic performance (Barry, 2010; Kimball, 2006). However, very few studies have demonstrated a causal relationship between art-based learning and improved memory (e.g., Hardiman et al., 2014; Paivio & Csapo, 1973). The findings from the current study suggest that drawing is superior to note taking for encoding semantic information to be recalled shortly after learning, and remains at least as good as note taking after a 20-minute delay. Although the long-term effectiveness of a drawing mnemonic is unknown, results from the present study contribute to the existing literature base on the benefits of arts integration.

Results from the present study are compatible with the emphasis on enhanced encoding in picture superiority effect theories. Both the dual-coding hypothesis (Paivio et al., 1968) and sensory semantic encoding hypothesis (Nelson, Reed, & Walling, 1976) claim that visual stimuli elicits superior encoding. Paivio and Csapo (1973) previously demonstrated that drawing encodes singular pieces of information more effectively than writing. The present study demonstrated that the picture superiority effect also applies to drawing associated information when tested immediately after learning. This distinction is important since educational information is typically taught in the form of associations (e.g., vocabulary term with a meaning, date with an event, etc.). While picture superiority effect studies supplied indirect evidence of arts integration effectiveness, the current study provides more direct evidence.

Furthermore, many qualitative studies suggest that arts integration is more engaging than traditional forms of learning (Clover, 2006; Collins & Ogier, 2012; Deaver, 2012; de la Croix et al., 2011; Hughes, 2009; Sutherland, 2013). Some school administrators might object to arts integration because they believe that while drawing is more enjoyable, it is less effective than other forms of learning. This study has provided evidence that this is not the case, as drawing was found to be superior immediately after learning and at least equal after a delay. Thus, for students with attention deficits or those who find traditional studying under-stimulating, drawing might be a more enjoyable way to encode information while still retaining the benefits that traditional schooling provides.

Results found in this study interpreted in conjunction with other studies on art based learning (e.g., Barry, 2010; Clover, 2006; Collins & Ogier, 2012; Deaver, 2012; de la Croix et al., 2011; DeMoss & Morris, 2002; Hardiman et al., 2014; Hughes, 2009; Kimball, 2006; Sutherland, 2013; Thomas & Arnold, 2011) suggest that academics should integrate artistic activities, including drawing, into lesson plans. School projects that employ art can be a fun and effective way to learn information. For example, drawings that symbolize important figures and their contributions can assist students in remembering historic information, while also providing the enjoyment of creating art. These types of projects do not need to be limited to K−12 schooling; the present study has demonstrated that art-based learning is also helpful for adults. As such, arts integration can also be applied to college learning.

In addition to school projects, drawing as a mnemonic could be taught as a study method or memorization technique. Common mnemonics currently taught in school include rhymes such as, "I before e, except after c, or when sounding like A, as in neighbor or weigh," the alphabet song, and ROY G. BIV (Red, Orange, Yellow, Green, Blue, Indigo, Violet). This study has helped demonstrate that mnemonics do not need to be limited to verbal methods. If students learned to use drawing as a mnemonic, studying might be easier, more effective, and more enjoyable.

Delimitations and Limitations

Delimitations. The artificial environment of this research was a delimitation of the study. Although teaching and testing in a classroom would enhance the applicability of the experiment, it would also introduce confounding variables. Participants were tested under controlled conditions to isolate both memory (rather than cognition in general) and art medium (i.e., drawing) as variables. While such controlled conditions are important for research, a paired associates task is not typical in a classroom, and responses on that task may not necessarily represent how students perform in an academic setting. However, using novel word pairs minimizes confounding variables such as prior knowledge while still being fairly representative of the associative learning that takes place in classrooms. In addition, paired associates tests have been used since 1894 to assess memory, and are still frequently used in memory research (Bower, 2000).

Presentation time for each word pair was also controlled to minimize differences between conditions. Real world applications might vary in the amount of time participants need and are willing to spend on drawing versus note taking. Additionally, real world applications would likely allow for continued rehearsal over time, which the 25-second period does not allow and therefore might affect results.

Inclusion criteria of being between the ages of 18−70 years and having a GED or high school diploma were also delimitations in the present study. Purposefully controlling for these factors limited the range of intelligence, memory capacity, and developmental differences. Doing so restricted potential confounds, but also limited generalizability of results to individuals between the ages of 18−70 years with similar schooling experience. This is a small limitation, however, as many studies use only a college population.

Another delimitation was use of a within-subjects design. This design allowed for a smaller sample size, as fewer participants were needed than a between-subjects design would require. It also reduced error variance since participants served as their own controls. Despite these advantages, such a design can produce sequencing effects. Groups were counterbalanced to minimize these effects.

Limitations. Due to the modest sample size ($N = 35$), lack of statistically significant results from the ANOVA could be due to limited statistical power. A post hoc power analysis indicated that an effect size of .30 would require 88 people to achieve the recommended statistical power of .80 (as suggested by Cohen, 1992). Continued research with a larger sample size is therefore recommended.

Another limitation was the absence of memory decay between the immediate and delayed test on the NT condition. The decrease in scores between the immediate and delayed test on the DM condition was not significant, and therefore there is insufficient evidence to support the claim that memory decay occurs after 20 minutes. As stated previously, the delayed test was likely administered too soon to allow for memory decay, and additional research is warranted to determine memory decay effects over a longer duration.

Additionally, the present study measured memory solely with word pair association tests. Doing so might have created mono-method bias, which occurs when evaluating a construct with only one type of measure. Performance on the present study's post-tests therefore does not necessarily reflect memory as a whole.

Lastly, the sample population demonstrated higher verbal memory than the larger population, as scores on the VPA subtest were in the above average range. Mean scores on the VPA subtest were also higher than on the VR subtest, indicating a slight advantage for verbal over visual memory in comparison to the larger population. As such, results might not be entirely generalizable, and the effectiveness of a drawing mnemonic might be understated.

Future Research

This study was unable to produce memory decay, and in fact indicated improvement in the NT condition over time. It is unknown whether these results were due to inferior consolidation, less rapid consolidation, associative interference, or another factor. Therefore, experiments that examine the effectiveness of a drawing mnemonic over longer durations of time and with different distractor tasks are warranted.

Additionally, studying often entails some form of rehearsal, which can affect retention rates. The current study only allowed for rehearsal in a concentrated period of time (25 seconds). Future research should examine the effects of spaced rehearsal on a drawing mnemonic, especially since enjoyable rehearsal has been named as one of the benefits of art-based learning (see Rinne et al., 2011). Doing so might also increase memory for the words that drawings represent, given that many participants remembered the images they drew but not the associated words.

Furthermore, more practice using a DM might be warranted. Doing so would reduce the confounding variable that a DM is a relatively novel way of learning for many people, and help them develop the best way to represent information. In the same vein, a qualitative analysis comparing successful to unsuccessful DMs might help determine what characteristics of drawings are most helpful to memorize information.

Research that uses stimuli that better represents classroom learning might also compensate for this difficulty to remember exact words. Classroom learning such as learning vocabulary definitions, concepts, and facts do not necessarily require exact words, and synonyms can be used (i.e., there are multiple ways to state the same definition, concept, or fact). The design for the current study was purposely simplified to minimize confounding variables, but future research that mirrors classroom learning and uses more meaningful subject matter (e.g., vocabulary terms, concepts, facts, etc.) might be advantageous.

The present study is one of the few experimental studies on arts integration. As mentioned previously, a within-subjects design has many benefits, but also limitations such as sequence effects. For this reason, further experimental research using a between-subjects design is suggested.

Conclusion

Research on arts integration has demonstrated increased student engagement with learning, and students typically report deeper understanding of subjects (Clover, 2006; Collins & Ogier, 2012; Deaver, 2012; de la Croix et al., 2011; Hughes, 2009; Sutherland, 2013). However, research on art-based learning has been primarily holistic and qualitative. The present study sought to gather quantitative experimental data that isolated memory as a variable in order to help fill the existing gap in arts integration literature.

The current study demonstrated enhanced encoding when drawing is used as a mnemonic in comparison to note taking. In conjunction with other studies on art-based learning, these findings give credibility to the notion that arts integration is an effective method of learning, and perhaps more effective than traditional approaches to education. Topics for future research include evaluating the effects of rehearsal, qualities of effective DMs, effects of practice with a DM, and the long-term effectiveness of a DM.

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Appendix A

Demographic Data Form

Appendix A

Demographic Data Form

Please fill in your age and check the boxes below that describe you. Feel free to skip any questions you feel uncomfortable answering.

Participant code: ____________________________

1. **Age:** ____________________________

2. **Biological sex: (check one)**
☐Female ☐Male ☐Intersex

3. **Gender identity: (check one)**
☐Female ☐Male ☐Androgynous ☐Other (please specify)___________________

4. **Sexual orientation: (check one)**
☐Straight ☐Bisexual ☐Gay/Lesbian ☐Other (please specify) ___________________

5. **Relationship status: (check all that apply)**
☐Single ☐Partnered ☐Married ☐Separated ☐Divorced ☐Widowed

6. **Race: (check all that apply)**
☐African American ☐Asian ☐Caucasian ☐Hispanic ☐Indian (from India)
☐Native American ☐Pacific Islander ☐Other (please specify) __________________

7. **Highest level of education achieved: (check one)**
☐High school diploma ☐GED ☐Associate Degree ☐Bachelor's Degree
☐Master's Degree ☐Doctoral Degree ☐Other technical degree

8. **Employment status: (check one)**
☐Unemployed ☐Full Time Employment ☐Part Time Employment
☐Full Time Student

9. **Annual Income(check one)**
☐$0-$9,999 ☐$10,000-$19,999 ☐$20,000-$29,999 ☐$30,000-$49,999

☐$50,000-$79,999 ☐$80,000-$99,999 ☐$100,000+

10. Is English your first language? (check one)
☐Yes ☐No

11. If no, primary language__________________

12. Do you identify as having a disability?
☐Yes ☐No

13. If yes, please specify: __________________

Appendix B

Random Assignment

Appendix B

Random Assignment

1 = Group 1

2 = Group 2

Group 1 = DM-NT-DM-NT

Group 2 = NT-DM-NT-DM

1. 1
2. 2
3. 2
4. 2
5. 1
6. 2
7. 2
8. 1
9. 2
10. 2
11. 2
12. 2
13. 2
14. 1
15. 2
16. 2
17. 1
18. 1
19. 1
20. 1
21. 1
22. 1
23. 1
24. 2
25. 1
26. 1
27. 1
28. 2
29. 2
30. 2
31. 1
32. 2
33. 1
34. 1
35. 2
36. 2

Appendix C

Script and Instructions

Appendix C

Script and Instructions

Script for All Participants

Thank you for agreeing to meet to discuss and potentially participate in this study. My name is Leslie Baker, and I am a doctoral student at Antioch University Seattle conducting a study on memory techniques. For agreeing to meet with me, I am giving you a $20 gift card [hand gift card]. First I will review the informed consent form, ask you if you have any questions, and if you choose to participate, we will begin the procedure. Do you have any questions?

Here is the informed consent form, which details your rights as a participant. You are under no obligation to sign this form. This section [point to Procedures section] explains what procedures will take place today. This section [point to Duration section] explains how long it will take. This section [point to Possible Risks section] explains some of the possible risks, which include the chance that you may feel that you have performed poorly on a test. Most people are unable to answer all of the questions correctly. Please note that memory capacity and processing speed do not necessarily reflect intelligence. Also, you will be asked to draw images and write notes. For some, these activities may not seem easy to you. You will not be evaluated or judged based on your drawing or note taking. The drawings and notes are to help you memorize the information only. Possible benefits include the opportunity to learn about this research, which may be useful to you if you must regularly memorize information. Additionally, your participation will contribute to the field of psychology and education.

Please note that your participation is voluntary and you can stop at any time. Also, results will be kept confidential. Here is a number that you can call if you have any questions or concerns about what has taken place today [point to dissertation chair's phone number on informed consent form]. You may also contact this phone number here [point to IRB chair's phone number on informed consent form]. Please take your time to read this form and let me know if you have any questions. [Questions are answered and if participant chooses to, informed consent is signed].

Instructions for Group 1

Word Presentation. This computer will present 44 word pairs that you will later be tested on. You will be given 25 seconds to memorize each word pair. For the first set of word pairs, please create an image that helps you remember the connection between the words. For example, if one word is "horse" and the other is "jump," you might draw a picture of a horse jumping. Please make sure to connect to the two concepts somehow, and do not draw separate drawings. You may use words in your drawings if you would like. Please note that you will not be judged on your artistic ability, the drawing is to help you memorize the information only. Let's do a trial run so you can familiarize yourself with the procedure; remember to draw an image that connects the two words [click Drawing Trial]. [*After trial is complete*] Do you have any questions?

For the next set of word pairs, please write notes to help you remember the connection between the words. You can write any sort of notes you like, as long as you do not draw an image. Let's do a trial run so you can familiarize yourself with the procedure [click Note Taking Trial]. [*After trial is complete*] Do you have any questions?

You see there are four phases, each with 11 word pairs [point to phase buttons]. You will do drawing for the first phase, note taking for the second, drawing for the third, and note taking for the last phase. I will remind you before you start each set what you are supposed to do. Do you have any questions?

Instructions for Group 2

Word Presentation. This computer will present 44 word pairs that you will later be tested on. You will be given 25 seconds to memorize each word pair. For the first set of word pairs, please write notes to help you memorize the word pairs. You can write any sort of notes you like, as long as you do not draw an image. Let's do a trial run so you can familiarize yourself with the procedure [click Note Taking Trial]. [*After trial is complete*] Do you have any questions?

For the next set of word pairs, please create an image that connects the two words. For example, if one word is "horse" and the other is "jump," you might draw a picture of a horse jumping. Please make sure to connect to the two concepts somehow, and do not draw separate drawings. You may use words in your drawings if you would like. Please note that you will not be judged on your artistic ability, the drawing is to help you memorize the information only. Let's do a trial run so you can familiarize yourself with the procedure; remember to draw an image that connects the two words [click Drawing Trial]. [*After trial is complete*] Do you have any questions?

You see there are four phases, each with 11 word pairs [point to phase buttons]. You will do drawing for the first phase, note taking for the second, drawing for the third, and note taking for the last phase. I will remind you before you start each set what you are supposed to do. Do you have any questions?

Instructions for Both Groups after Word Pair Presentation

First Word Pair Test (Test 1 for Group 1, Test 2 for Group 2). You will now take the first memory test. When a word comes up, please try to remember what other word goes with it from the word pairs that you were just presented. When you think you know the answer, type the other word in the box next to the first word. If you cannot remember a word, enter a question mark in the box. Then click “next” or the enter key. Please note that once you click “next” or the enter key you will not be able to go back to any previous words. Do you have any questions?

Sudoku Puzzles. Here is a Sudoku puzzle. Enter numbers into the blank spaces so that each row, column and three by three box contains the numbers one to nine. I will give you 20 minutes. Do you have any questions?

Second Word Pair Test (Test 2 for Group 1, Test 1 for Group 2). You will now take the second memory test. When a word comes up, please try to remember what other word goes with it from the word pairs were presented earlier. When you think you know the answer, type the other word in the box next to the first word. If you cannot remember a word, enter a question mark in the box. Then click “next” or hit the enter key. Please note that once you click “next” or the enter key you will not be able to go back to any previous words. Do you have any questions?

Processing Speed and Memory Subtests. You will now be given three short tests. [Follow standardized protocol for WAIS-IV and WMS-IV.]

Demographic Data Form. Now that you have completed those tests, please fill out this demographic data form by checking the boxes that apply to you. Feel free to skip any questions you feel uncomfortable answering. [Hand demographic data form.]

Debriefing. We have completed the procedure. This study looked at different techniques to memorize information. Do you have any questions about the study or what took place here today?